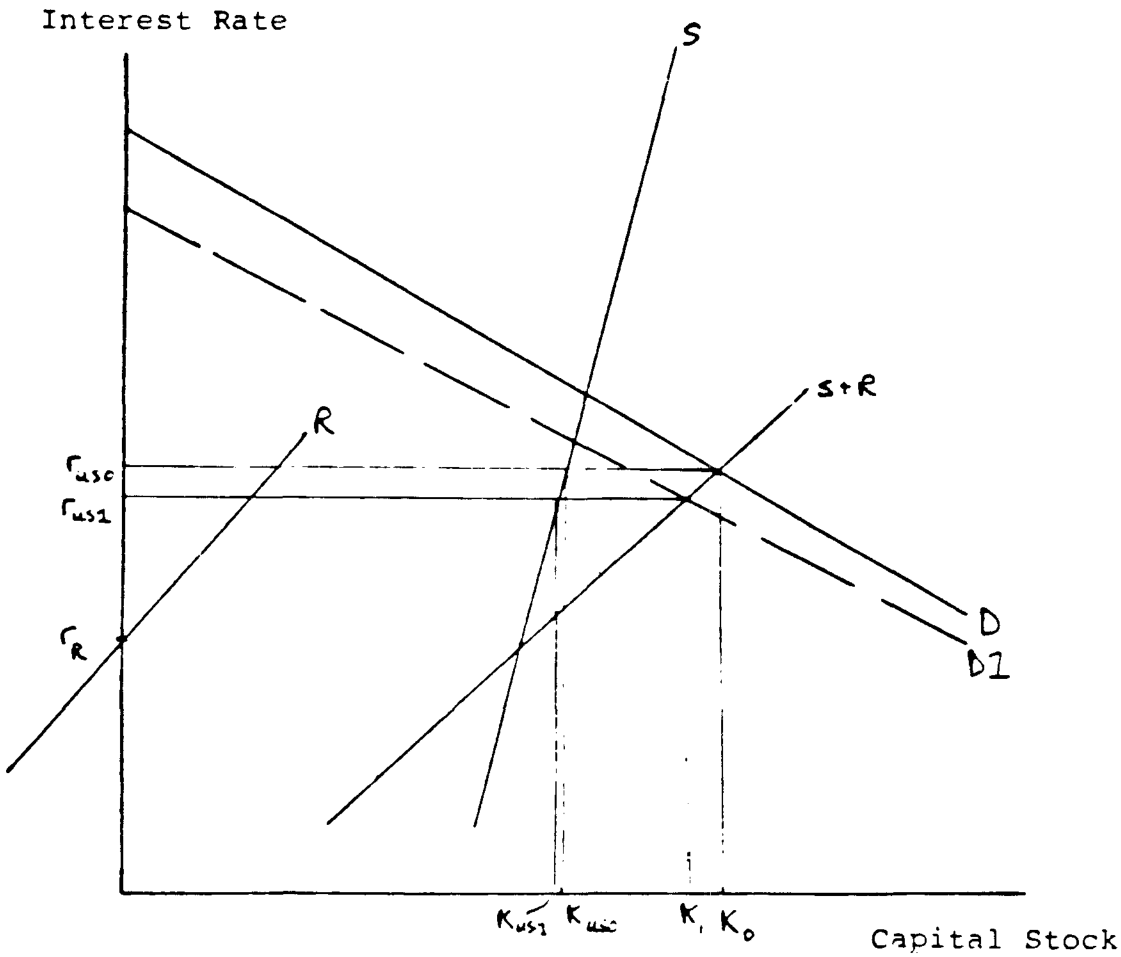
Figure 8.

Effects of Capital Income Tax in Large Open Economy with One Asset



above that domestic capital is likely to change more sharply than domestic wealth in response to a development like a domestic tax change. 31/ However, any change in efficiency from more neutral capital income taxation increases both domestic and national product.

Since the United States is large relative to the rest of the world, the capital outflow is potentially big enough to reduce the world interest rate. Part of the process of convergence to a new steady-state economy is a decline in the world rate, helping to reestablish an equilibrium differential. This is not shown in the figure, but it is accounted for in the calculations below by modeling the demand for capital and the determination of interest rates in the rest of the world explicitly.

One reason why the decline in domestic product associated with the net capital outflow may be important is that the underlying reduction in domestic capital may have effects on domestic labor productivity. While the evidence is not conclusive, several studies have suggested that the growth of labor productivity and real wages may depend on the growth of the capital/labor ratio. Both could suffer if an outflow of capital occurs. 32/

HOW BIG ARE THESE EFFECTS?

In order to estimate the magnitude of these effects one needs a long-run economic model. It is customary to use large-scale computable general equilibrium models for this purpose. Fullerton and Henderson, in particular, have provided model results on various economic implications of fundamental tax reform. 33/

31. For a more complete discussion of the effects of saving and investment incentives in an open economy, see Edward M. Gramlich, "Saving, Investment, and the Tax Reform Act of 1986," *Proceedings of the 1986 Annual Meetings of the National Tax Association*, forthcoming, and Joel Slemrod, "International Capital Mobility and the Theory of Capital Income Taxation," paper presented to the Brookings Tax Conference, October 31, 1986.

32. For a detailed discussion of the recent literature on the determinants of productivity growth, see Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1988-1992* (January 1987), pp. 71-108.

33. Don Fullerton, and Yolanda Kondrzycki Henderson, "A Disaggregated Equilibrium Model of the Tax Distortions Among Assets, Sectors, and Industries," National Bureau of Economic Research Working Paper 1905 (April 1986); and Don Fullerton and Yolanda Kondrzycki Henderson, "The Impact of Fundamental Tax Reform on the Allocation of Resources," *American Enterprise Institute Occasional Papers*, Working Paper 8 (April 1986).

This paper takes an alternative approach to long-run modeling--the neoclassical growth model. The chief difference between growth models and the typical general-equilibrium model is that while the former are less sophisticated, they are also more tractable. This makes it easier, for example, to model the reactions of the world economy to developments in this country--an important part of the analysis, as the above discussion has shown. This section presents results from both a closed-economy growth model and a large-open-economy formulation. 34/

The Closed-Economy Approach

This model consists of a production function that relates per-effective-worker gross output to the per-effective-worker stocks of five types of capital; a saving function; a relatively detailed representation of the financial portfolio in which saving can be invested; and equations for the real and nominal interest rates and the price level. The production function is a Cobb-Douglas form that incorporates at least a moderate degree of sensitivity of the stock of each type of capital to changes in its net rate of return.

Saving is added to financial wealth, which is stored in three assets: government-issued (high-powered) money, productive capital, and interest-bearing government debt. Interest-bearing debt and claims to capital are assumed to be perfect substitutes; their after-tax yield is the interest rate in this model. This interest rate is related to the marginal productivities of the different types of capital by their user cost equations.

Federal policy variables exogenous to the model are the primary government budget deficit, the effective tax rates on the income from different types of capital, and the growth rate of the money supply. The growth rate of the labor force and the rate of technical progress are fixed by assumption. The sum of the labor force growth rate and the rate of technical progress is the growth rate of the effective labor force.

This formulation roughly represents the long-run model underlying the putty-putty and putty-clay variants of the short-run model used in the last section. Here, as in the last section, a stylized life-cycle consumption function in which possible interest-elasticity is suppressed, and a Cobb-Douglas production technology, are assumed. The emphasis in this section is

34. The models used here are modified versions of that described in Frederick Ribe, and William Beeman, "The Monetary-Fiscal Mix and Long-Run Growth in an Open Economy," *American Economic Review* (May 1986), pp. 209-212. Somewhat similar approaches can be found in Jeffrey, Sachs, "Energy and Growth under Flexible Exchange Rates: A Simulation Study," in J.S. Bhandari and B.H. Putnam, eds., *Economic Interdependence and Flexible Exchange Rates* (Cambridge: MIT Press, 1984), pp. 191-220, and David Lipton, and Jeffrey Sachs, "Accumulation and Growth in a Two-Country Model," *Journal of International Economics*, vol. 15, pp. 135-159.

entirely different, however, in that it is placed on changes in stocks of capital and the output that they yield. These are long-run issues by definition, and hence were absent in the short-run discussion above.

The Formal Closed-Economy Model

All dollar-denominated variables are expressed here in real terms per unit of technical-progress-augmented labor, unless otherwise noted. The production function is

(1) $$y_t = b\, k1_t^{a1} k2_t^{a2} k3_t^{a3} k4_t^{a4} k5_t^{a5},$$

where y_t is output and $k1_t \ldots k5_t$ are the stocks of capital of kinds 1 through 5 in period t. The ai and b are parameters.

Claims to the five types of capital are perfect substitutes for each other and for interest-bearing government debt, d_t. Together they are referred to as "securities," s_t:

(2) $$k1_t + k2_t + k3_t + k4_t + k5_t + d_t = s_t.$$

It is assumed that the marginal product of each type of capital, gross of taxes, is equal to its gross user cost, which reflects the level of taxation:

(3)-(7) $$MPk_{it} = (r_t + dep_i)H_{it}, \quad i = 1,2\ldots5.$$

Here, r_t is the real interest rate, dep_i is the economic depreciation rate of capital of type i, and H_i is the factor by which the user cost for type-i capital is related to the sum of the real interest rate and the economic depreciation rate. A common user-cost expression, only slightly modified from that first put forward by Hall and Jorgenson, 35/ is

(8) $$uc = (r + dep)\, q\, (1\text{-}k\text{-}uz\text{-}un).$$

Here, q is the relative price of the asset in question, k is the effective investment tax credit rate, u is the statutory marginal tax rate on capital income, z is the present value of depreciation deductions, and n is the present value of interest deductions. Thus,

$$H = q(1\text{-}k\text{-}uz\text{-}un).$$

35. Hall and Jorgenson, op. cit.

The H_i are positively related by simple formulas to the effective tax rates (net of depreciation) on income from capital of different types as estimated by Henderson:

(9) $t_{eff} = [uc-(r+dep)]/(uc-dep)$.

Substituting (8) for $\underline{c}$ in (9) shows that t_{eff} can be expressed as

(10) $t_{eff} = (r+dep)(H-1)/[rH+dep(H-1)]$.

Using (10), the relationship between t_{eff} and H can easily be shown to be unambiguously positive.

Financial wealth is given by last period's wealth plus interest earnings plus new saving:

(11) $w_t = w_{t-1}[(1+r_t)/(1+G_t)] + y_t - c_t$,

where G_t is the nominal growth rate (the sum of the rate of technical progress and the growth rates of the labor force and the price level), and c_t is consumption.

Consumption is given by a stylized function of human and financial wealth:

(12) $c_t = m_1 y_t + m_2 w_{t-1}$.

Human wealth is assumed to be proportional to the labor share of national income, which in turn is proportional, given the constant-share Cobb-Douglas production function, to output itself. The parameter m_1 reflects both the (constant) labor share of output and the (constant) propensity to consume out of human wealth.

Wealth is held in a portfolio consisting of outside money, m_t, and securities, s_t, as defined above. The allocation of wealth among these assets is given by:

(13) $m_t/w_t = o_{11} + o_{12} i_t$

(14) $s_t/w_t = o_{21} + o_{22} i_t$,

where, following straightforward Brainard-Tobin principles, $o_{11} + o_{21} = 1$, $o_{12} + o_{22} = 0$. i_t is the nominal interest rate, whose determination is described below. 36/ In the simulations, (13) is rearranged by first substituting in the definition for m_t in terms of the aggregate nominal money stock M_t, the augmented labor force N_t, and the price level, p_t:

(15) $m_t = M_t/p_t N_t$.

Once this is done, (13) is solved for the price level:

(13) $p_t = M_t /(o_{11} + o_{12} i_t) w_t N_t$.

The nominal interest rate is derived in two different ways in alternative versions of the model. One uses adaptive expectations of inflation:

(16a) $i_t = r_t + (p_t/p_{t-1})\text{-}1$,

and the other uses perfect foresight regarding inflation, involving Fair's iterative three-stage method of solving rational-expectations models: 37/

(16b) $i_t = r_t + (p_{t+1}/p_t)\text{-}1$.

It turned out that the properties of the solutions with these two methods did not differ noticeably, so the simpler version (16a) is used in deriving the results used in this study.

The evolution of the stock of interest-bearing government debt is given by the familiar difference equation:

(17) $d_t = d_{t-1} [(1+i_t)/(1+G_t)] + pd_t + m_t - m_{t-1}/(1+G_t)$

where pd_t is the primary budget deficit.

The 14 equations (1)-(7),(11)-(17) determine the 14 endogenous variables (without time subscripts) y, k1, k2, k3, k4, k5, r, c, w, p, s, m, i, and d. The policy variables M, pd, H1, H2, H3, H4, and H5 are exogenous, as is the technical-progress-augmented labor force, N.

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36. William Brainard and James Tobin are known for having pointed out these and other restrictions on individual equations in portfolio-allocation models. Such restrictions ensure that the equations are mutually consistent and that, taken together, they allocate precisely 100 percent of financial wealth among different assets. See "Pitfalls in Financial Model Building," *American Economic Review*, vol. 58 (May 1968).

37. Fair, op. cit.

The Open-Economy Model

The demand in each sector for imports of real goods from the other in the open-economy model is given by a simple function of income in the home sector and the real exchange rate. A more important way in which the representation of each of the two sectors in the open-economy model differs from that in the simpler U.S. model is that the portfolio of assets in which savers can invest their funds in either sector includes one more possibility: capital held in the other sector. If the interest rate in the other sector (adjusted for expected exchange-rate changes) rises relative to that in the home sector, wealthholders begin to invest some of their funds there instead of in domestic capital. This expands the stock of productive capital located in the other sector at the expense of that in the home sector. As the discussion below will show, however, the sensitivity of the flow of investment funds between sectors to differences in interest rates in the two sectors is not acute.

The exchange rate is determined by the balance of the demands for dollars and for rest-of-world currency: the dollar appreciates in response to higher net demands for dollars in order to buy either U.S. real goods or U.S.-issued financial assets, and vice-versa.

The Formal Open-Economy Model. Each of the two sectors of the open-economy model, representing the United States and the rest of the world, consists of the 14 equations given above for the closed-economy model with a few additions and replacements described here. First, each sector has a demand equation for imports of goods and services from the other sector:

$$(18) \qquad im_t = f\,y_t\,[p^*_t\,e_t/p_t]h$$

where p^*_t is the internal price level in the other sector and e_t is the nominal exchange rate expressed in terms of dollars per unit of foreign currency, f is a parameter, and h is the price elasticity of demand.

No distinction is drawn between traded and nontraded goods, nor between the price of domestically produced goods and the price of a consumption basket. The inaccuracy created by these assumptions is minimized by the fact that imports are assumed to be zero in the initial steady state.

The portfolio equations (13)-(14) in the U.S. model are replaced with:

(13*) $m_t/w_t = q_{11} + q_{12}\, i_t + q_{13}\,[i^*_t + (e_t/e_{t-1}) - 1]$

(14*) $s_t/w_t = q_{21} + q22\, i_t + q_{23}\,[i^*_t + (e_t/e_{t-1}) - 1]$

(19) $f_t/w_t = q_{31} + q_{32}\, i_t + q_{33}\,[i^*_t + (e_t/e_{t-1}) - 1],$

where f_t is claims on the capital stock of the other sector, denominated in the currency of the holder of the claim, and i^*_t is the nominal interest rate in the other sector. The Brainard-Tobin adding-up constraints apply to the coefficients q_{ij}.

In view of the potential availability of foreign investment in domestically located capital, equation (2) of the the U.S. model is modified in the open-economy version to

(2*) $k1_t + k2_t + k3_t + k4_t + k5_t = (s_t - d_t) + f^*_t\, e_t\, p^*_t\, N^*_t/p_t\, N_t,$

where f^*_t, the rest of the world's holdings of U.S. capital, is converted from real per-rest-of-world-augmented-worker units of rest-of-world currency to real per-domestic-augmented-worker domestic currency by the factor $e_t\, p^*_t\, N^*_t/p_t\, N_t$. The ratio of the augmented labor forces in the two sectors, N^*_t/N_t, is assumed to be a constant and is the means by which the relative absolute scales of the two sectors are accounted for.

The exchange rate is determined in the balance-of-payments identity:

(20) $(f_t N_t p_t - f_{t-1} N_{t-1} p_{t-1}) - f_{t-1} N_{t-1} p_{t-1}\, i^*_t + im_t =$

$e_t[(f^*_t N^*_t p^*_t - f^*_{t-1} N^*_{t-1} p^*_{t-1}) - f^*_{t-1} N^*_{t-1} p^*_{t-1}\, i_t +$

$im^*_t]$.

Imports and claims on each sector by the other are represented here in aggregate nominal rather than per-effective-worker real terms. Once the indicated versions of equations (18) and (19) are substituted for im_t, im^*_t, f_t, and f^*_t, the equation becomes a polynomial of degree h+2, where h is the elasticity of import demand with respect to the real exchange rate. To keep the computations tractable, a value of unity is assumed here for h.

The production function in the open-economy model represents the determination of gross domestic product. Gross national product, by contrast, is approximated by:

(21) $yn_t = y_t + MPK^*_t\, f_t - MPK_t\, f^*_t\, e_t\, p^*_t\, N^*_t/p_t\, N_t.$

Here, MPK* is a vector of gross marginal products of capital in the rest-of-world sector, while MPK is the corresponding vector in the United States.

Net domestic product in each sector, yn, is derived from gross product by subtracting depreciation:

(22) $yd_t = y_t - dep\, k_t,$

where dep is a vector of depreciation rates shown in Table 10 corresponding to the five types of capital in this study. Net national product ynn_t is derived from gross national product in the same way:

(23) $ynn_t = yn_t - dep\, k_t.$

Calibrating the Models

The parameter values that were used in the simulations are shown in Table 11. To promote comparability of results, parameter values were chosen to match those in closely related models of Gramlich and Tobin. 38/ Unless otherwise noted, the values shown hold for both sectors.

The values q11 ....q33 result from an exercise with the capital-asset pricing model. Annual data for the period 1970-1979 were gathered on the one-year government note yield, consumer price index, and dollar exchange rate of each OECD country. 39/ The interest rates for the non-U.S. countries were adjusted for realized exchange-rate appreciation, and then converted to a composite non-U.S. weighted average using OECD figures on 1982 GDP shares of member countries as weights. 40/ These were in turn converted to real dollar yields by subtracting the rate of consumer-price inflation in the United States. What resulted were estimated real yields on three risky securities: U.S. government notes; a composite of non-U.S. OECD countries' government notes, adjusted for exchange appreciation; and holdings of U.S. government monetary liabilities (whose yield is the negative of the consumer-price inflation rate in the United States).

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38. Edward M. Gramlich, "How Bad are the Large Deficits?", in Gregory B. Mills and John L. Palmer, eds., *Federal Budget Policy in the 1980's* (Washington: Urban Insititute, 1984), pp. 43-68; and James Tobin, "The Monetary-Fiscal Mix: Long-Run Implications," *American Economic Review* (May 1986), pp. 213-218.

39. The source of these data was the International Monetary Fund's *International Financial Statistics* (various issues).

40. Organization for Economic Cooperation and Development, *OECD Economic Outlook* (December 1985), pp. 19-20.

TABLE 11. PARAMETER VALUES IN THE GROWTH MODELS

Parameter	Value	Parameter	Value
N*/N	1.500	h	1.000
b	0.690	q11	0.080
m1	0.300	q12	0.000
m2	0.155	q13	0.000
o11	0.060	q21	0.920
o12	-0.020	q22	9.300
o21	0.940	q23	-9.300
o22	-0.020	q31	0.000
f	0.000	q32	-9.300
g	1.000	q33	9.300
a1	0.074	a2	0.037
a3	0.028	a4	0.086
a5	0.025		

NOTES: The values ai were chosen to add up to the 0.26 total capital share output that is used in Gramlich. The shares of this total that are imputed to the different types of capital are taken from Fullerton and Henderson, "The Impact of Fundamental Tax Reform...," Table 8, Column 1. The b value is chosen, as in Gramlich, in order to normalize output in the initial steady state at unity. Values for M1 and M2 were chosen to yield a steady state wealth/income ratio close to that used in Tobin. The oii values were chosen arbitrarily, as were the unit price and income elasticities of import demand. Higher price elastiticities in this context result in an exchange-rate equation that is of a higher order than cubic in the exchange rate, and thus present computational difficulties. The ratio (N*/N), representing the relative sizes of the rest-of-world and U.S. economies, is based on OECD estimates of real output in member countries in 1982.

The covariance matrix of these three yields around their sample means was computed, and the coefficients of the linear demand equations for the three risky assets were derived from this matrix using a value of 2.0 for the Pratt coefficient of relative risk aversion in the algorithm supplied by Friedman and Roley. 41/ The values that emerged from this resulted in computational difficulties because the relatively strong interest-rate responsiveness of the demand for money they implied introduced instability into the price level and inflation rate, and hence into the rest of the model. For this reason, the coefficient values were manipulated, using statistically-derived coefficients just described only for rough guidance.

The unadjusted and final coefficients are shown in Table 12. The most important figures here are the values showing the responses of the demands for domestic interest-bearing assets ("Securities") and for foreign interest-bearing assets ("Foreign Assets") to changes in their own and each other's yields. In general, the coefficient for the response of each demand to a change in its own yield will be a positive number and the coefficient showing its response to the other asset's yield will be negative of at least of roughly the same absolute magnitude. The larger this absolute magnitude--which is to say, the closer it is to being effectively equal to infinity--the closer are the assets to being perfect substitutes.

How closely substitutable these assets appear to be for the U.S. data underlying Table 12 can be taken to reflect how "open" the U.S. economy is with respect to international capital flows. As was pointed out earlier in this paper, a defining characteristic of (small) open economies is that financial assets there and elsewhere in the world (for a given degree of risk) are perfect substitutes.

The results in Table 12 are difficult to judge on inspection as to the degree of substitutability that they imply. Simulation results with these and other hypothetical values, show, however, that they embody a finite, but relatively low, degree of substitutability between assets denominated in different national currencies. Qualitatively, this result is consistent with indirect evidence provided by Feldstein and by Horioka and Feldstein that there is imperfect substitutability in financial portfolios between claims to capital located in different countries. 42/ As the discussion below will point out, the "open" economy model based in part on these coefficient estimates

41. Benjamin Friedman, and V. Vance Roley, "A Note on the Derivation of Linear Homogeneous Asset Demand Functions," National Bureau of Economic Research, Working Paper 345 (May 1979), equation 20.

42. Martin Feldstein, and Charles Horioka, "Domestic Saving and International Capital Flows," *Economic Journal* (June 1980), pp.314-329; and Martin Feldstein, "Domestic Saving and International Capital Movements in the Long Run and the Short Run," *European Economic Review* (1983), pp.129-151. Qualitatively, the portfolio sector of the growth model and the results of disturbing its steady state are quite similar to those in section 5 of Feldstein's paper.

TABLE 12. ESTIMATED PORTFOLIO DEMAND COEFFICIENTS

Variable	Assets: Money	Securities	Foreign Assets
	Unadjusted Values		
Constant	0.132	0.848	0.020
Domestic Real Rate	1.155	7.790	-8.945
Foreign Real Rate	-2.299	-8.945	11.245
Inflation Rate	1.144	1.155	-2.299
	Adjusted Values		
Constant	0.080	0.920	0.000
Domestic Real Rate	0.000	9.300	-9.300
Foreign Real Rate	0.000	-9.300	9.300
Inflation Rate	0.000	0.000	0.000

yields the result in simulations of the Tax Reform Act that the interest rate falls by about 86 percent of the amount by which it falls in closed-economy simulations. This can be taken to imply roughly that the U.S. economy is "86 percent closed," in that the interest rate would not fall at all if this were a (small) completely open economy.

Simulation Results: The Closed Economy. In order to estimate the effects of the change in tax law on the long-run properties of the economy, the closed-economy model was simulated using values of the effective tax rates on business capital both before and after implementation of the Tax Reform Act. These two sets of estimated effective tax rates were taken from Yolanda Henderson and are shown in Table 10. 43/ Henderson's estimates concern corporate capital only; thus the analysis leaves out of account certain other significant parts of the U.S. capital stock--most importantly, owner-occupied housing. Consequently the results in the present paper may significantly overstate the efficiency gains from the tax change, since the Tax Reform Act appears to widen rather than narrow the differential between the tax rates on housing and on other kinds of capital.

43. Henderson, op.cit.

TABLE 13. STEADY-STATE VALUES OF MODEL VARIABLES

Variable	Value	Variable	Value
G	0.056	s	3.552
pd	0.016	d	0.454
H1	1.008	k	3.098
H2	1.303	f	0.000
H3	1.221	k1	0.488
H4	1.415	k2	0.504
H5	1.984	k3	0.434
y	1.000	k4	1.143
e	1.747	k5	0.529
yn	0.872	m	0.309
r	0.025	i	0.056
w	3.961	c	0.792
real growth rate:	0.025	inflation rate:	0.030

Initial domestic, rest-of-world price levels: 1.000

(These values are from the open-economy model. There are minor differences in the corresponding solution for the closed-economy model.)

A baseline steady state was computed using the effective tax rates for prior tax law. The properties of this steady state are shown in Table 13.

A new simulation was then done using the tax-rate estimates for the Tax Reform Act. These values were assumed to be implemented in the second year of the solution. The solution values in the first year are thus the baseline (steady-state) values that would hold continuously if there were no change in the effective tax rates from those in the previous law. The government was assumed to hold the stock of debt constant at its steady-state value through this exercise. All other policy variables are held constant at their baseline values.

The results of this simulation are shown by solid lines in Figures 9 and 10. The reduction in the variation in tax rates on capital income (increase in tax neutrality) causes an immediate increase in net output per effective worker of slightly more than one-tenth of a percentage point. 44/ There is a slight diminution in this level over time, however, and the new steady-

44. This magnitude is perhaps surprisingly small, but it should be borne in mind that other analysts have found similarly small magnitudes when estimating the effects of complete elimination of all tax distortions. See, for example, the two papers by Fullerton and Henderson cited earlier.

Figure 9.

Net Domestic Product in a Closed and an Open Economy

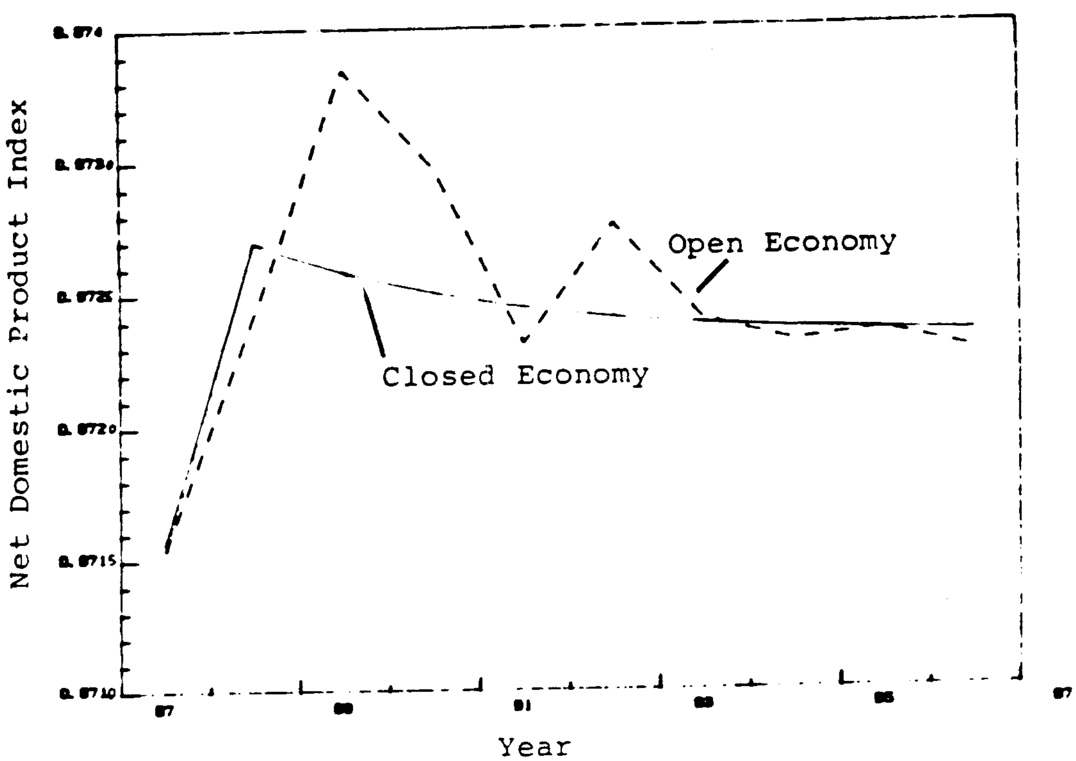
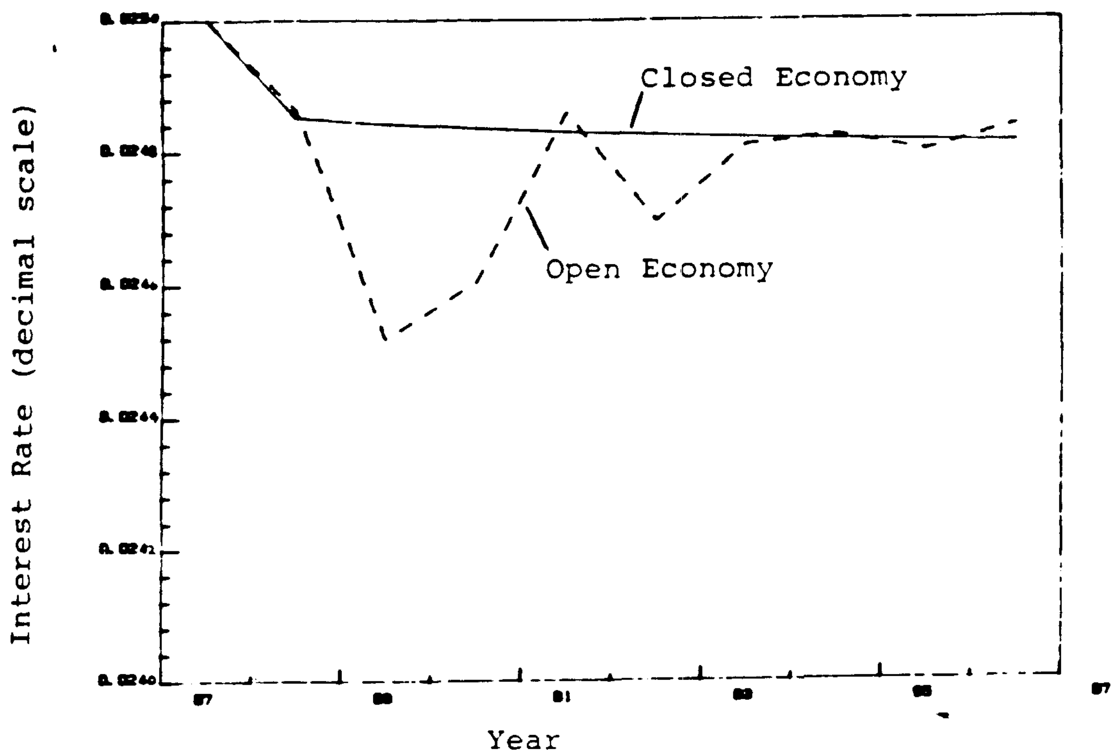


Figure 10.

Real Interest Rates in a Closed and an Open Economy



state level of real output per effective worker appears to be above the old steady-state value by slightly less than 0.1 percent. This diminution after an initial rise is caused by the dynamic adjustment of the aggregate capital stock to the disturbance represented by the increase in capital efficiency. The increase in output and income (from the once-and-for-all increase in capital efficiency) raises the flow of domestic private saving in dollar terms, since saving is a linear function of income, among other variables. The increased saving flow raises the growth rate of the aggregate capital stock, but this increase is only temporary. As the capital stock grows, the increased dollar saving flow becomes smaller and smaller relative to the capital stock--which is to say, the growth rate of capital falls steadily after its initial increase. The decline stops when the growth rate has fallen back to that of the augmented labor force, at which point a new steady state is established. This steady state represents higher levels of income and capital per worker than in the baseline solution. The increase in capital efficiency brought about by the increase in tax neutrality leads to a permanently higher path of income and therefore of private domestic saving, and this in turn leads to a permanently higher path of capital per worker than was true before the tax change.

The real interest rate falls very slightly (by slightly less than two basis points, or 0.02 percentage point).

Stimulation Results: The Open Economy. In order to investigate the role of intersectoral capital flows, the same simulations that are reported above were done in the open-economy version of the growth model. The results are shown with dashed lines in Figures 9 and 10, and in Figure 11.

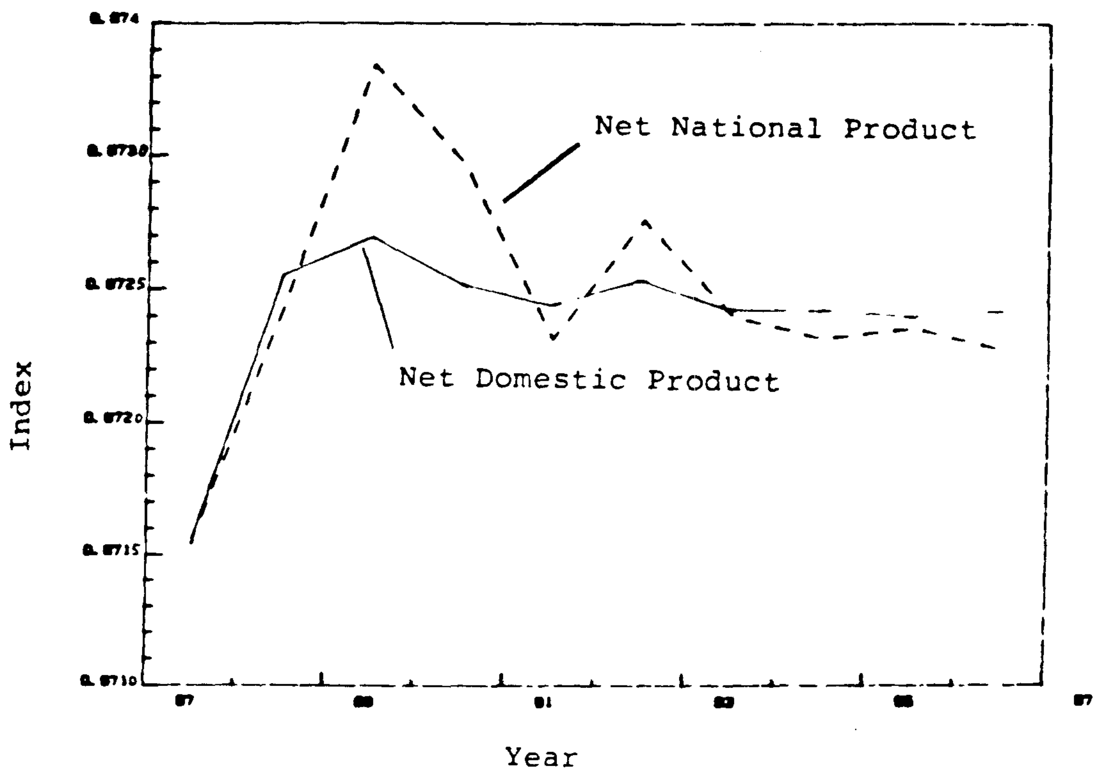
In the open-economy calculations, the tax bill's effect in lowering the U.S. interest rate causes a net capital outflow after some adjustment. This outflow ultimately mitigates the U.S. interest-rate decline, although not by very much; after ten years, the decline in the rate is about 86 percent of the decline in the closed-economy simulation.

In and of itself, the capital outflow causes a small reduction in net domestic product of about 0.01 percent after 10 years. This partly offsets the increase caused by the tax change through its reduction in the differences among tax rates on different types of capital.

In the simulations, the net effect of the capital outflow on national (as opposed to domestic) product is small--about 0.02 percent. This is because the funds that flow out of the country are invested in capital abroad, where they pay a return to U.S. nationals that is quite close to what they paid when invested in assets located within the country. Thus the overall

Figure 11.

Net Domestic Product and Net National Product in an Open Economy



effect of tax reform on national product in the U.S. is a little over one tenth of baseline output (about 0.12 percent). This figure primarily reflects the efficiency gains from more equal tax rates on different capital assets, but also includes a small net contribution from the substitution of capital held abroad for capital held domestically.

As a distributional matter, the increase in national product at the expense of domestic product is likely to be primarily reflected in increased payments to capital owners rather than to workers. That is, the increase in national product is an increase earned by capital, and in particular capital held abroad; the income to which it gives rise will flow to the owners (stockholders and bondholders) of that capital. By contrast, the lower level of domestic product is likely to be reflected primarily in the incomes of workers.

Principal Sources of Uncertainty

The results described here depend on a number of parameters about which only sketchy information is available. The most prominent of these is the elasticity of substitution in financial portfolios among claims to capital located in different countries (that is, valued in different currencies). The estimate underlying the results shown above is derived using data on the correlations among real exchange-adjusted returns on one-year bonds in different countries. While this may represent a good first guess at the needed parameter value, it could be in error. From one point of view, this estimate seems likely to be too high, since it is derived using data for relatively short-term securities: it is likely that investors view short-term securities denominated in different currencies as closer substitutes than they do real assets like corporate capital. From another point of view, however, the elasticity estimate appears too low, because it results in very modest capital-flow responses to international interest-rate differentials.

Private Domestic Saving. The interest rate might fall even less if private domestic saving were more responsive to changes in this rate, as the discussion earlier in this section suggested. To investigate this possibility, alternative calculations were done using the higher degree of saving responsiveness estimated by Boskin. 45/ This change made little difference to the results, in part because the Tax Reform Act introduces a relatively small change in interest rates and in part because the Boskin responsiveness estimate, while larger than many, is still small in absolute

45. Michael J. Boskin, "Taxation, Saving, and the Rate of Interest," *Journal of Political Economy* (April 1978), pp. S3-S27.

terms. The much larger saving elasticities discussed more recently by Summers were not investigated, but they might have made a difference to the results. 46/

The Elasticity of Substitution in Production. The production function assumed in the model incorporates a unit elasticity of substitution among different types of capital. This assumption is commonly used in other studies. Fullerton and Henderson, however, report empirical estimates by various authors of elasticities of substitution between equipment and structures that are higher than unity, and show that higher values would increase the output gain from more neutral taxation. 47/

46. Lawrence Summers, "Capital Taxation and Accumulation in a Life Cycle Growth Model," *American Economic Review* (September 1981), pp. 533-544 (1981a).

47. Fullerton and Henderson, "A Disaggregated Equilibrium Model."

APPENDIX

APPENDIX I

IDENTITIES IN THE SHORT-RUN ECONOMETRIC MODEL

Gross Corporate Product

Y = GNP82

[the (change in) real gross corporate product is assumed to equal that in real GNP];

User Costs for Business Capital, Housing, Consumer Durables

cpde = f(r;....)
cnrst = f(r;....)
cho = f(r;....)
chr = f(r;....)
cc = f(r;....)
co = f(r;....)

[The (changes in) the user costs for producers' durable equipment, nonresidential structures, owner-occupied housing, rental housing, consumer automobiles, and other consumer durables were computed using the CBO rental-price model. This model, which is described elsewhere in the text, incorporates a conventional user-cost formulation. In the model calculations, static impacts on spending were computed by first calculating changes in user costs implied by the Tax Reform Act as regards depreciation deductions, investment tax credit rates, and statutory tax rates; these calculations were based on values from the current CBO baseline forecast for all economic variables entering the user costs, such as relative asset prices, nominal interest rates, the dividend/price ratio, and inflation rates. In the full-model calculations, these static impacts were augmented by computing changes in user costs implied by changes in the nominal Treasury-bill rate from the model solution. All interest rates entering the user cost were assumed to change by this amount. No other economic variables were assumed to change.]

Residential Investment

Ir = exp(QEH x N)

Stocks of Business Capital, Housing, and Consumer Durables

$$Kpde = (1\text{-}dpde)Kpde_{t-1} + Ipde$$

$$Knrst = (1\text{-}dnrst)Knrst_{t-1} + Inrst$$

$$(KH1 + KH5) = ((1\text{-}dh1)KH1 + (1\text{-}dh5)KH5)_{t-1} + Ir$$

$$CSTOCK = (1\text{-}dc)CSTOCK_{t-1} + EC$$

$$OSTOCK = (1\text{-}do)OSTOCK_{t-1} + EO$$

[The real net stocks of producers' durable equipment, nonresidential structures, houses, consumer autos, and other consumer durables were computed using the perpetual-inventory identities given above. The "di" terms are real depreciation rates. In the simulations, only the changes in these stocks from their baseline levels were needed, and not the levels. The change in each stock is computed using a variant of the above equations of the form (delta K) = (delta I) + (1-d)(delta I)$_{t-1}$ + (1-d)2(delta I)$_{t-2}$ + ..., where as many lagged terms were included in a given period as were required to sum over all investment changes back to the beginning of the simulation period.]

Population

$$N = N_{t-1} (1 + g_{1985})$$

[Estimated population is projected forward using its observed 1985 growth-rate.]

Effective Mortgage Rate

$$RMEFF = RTB$$

[Changes from the baseline in the effective mortgage rate were assumed to equal those in the Treasury bill rate.]

Unemployment Rate

$$U = U_{baseline}$$

[Given the relatively small changes in GNP that emerged from the calculations, possible changes in the unemployment rate were neglected.]

Values of Other Asset Stocks

$$DBT = DBT_{baseline}$$

$$ASF = ASF_{baseline}$$

$$VST = VST_{baseline}$$

$$VCNF = VCNF_{baseline}$$

[Changes from baseline in financial stock values were neglected.]

$$VCNR = KH1 + CSTOCK + OSTOCK$$

Real GNP

$$GNP82 = CON + EC + EO + Ipde + Inrst + Ir - IM$$

[The change in real GNP is taken to be the sum of the changes in consumption and investment minus the change in imports.]

Nominal GNP

$$GNP = GNP82 \times PGNP_{baseline}$$

[The path of the GNP deflator is assumed to be unchanged in the simulations.]

Income Shares

$$YL = (YL/GNP)_{1985:4} \times GNP$$

$$YTR = (YTR/GNP)_{1985:4} \times GNP$$

$$YPR1 = (YPR1/GNP)_{1985:4} \times GNP$$

$$YPR2 = (YPR2/GNP)_{1985:4} \times GNP$$

[Income shares were assumed to remain constant at their 1985:4 values.]

M2 Opportunity Cost

$$OPP = RTB - (a1_{1985:4} RCB_{1985:4} + a2_{1985:4} RTB)$$

$$= RTB (1 - a2_{1985:4}) - a1_{1985:4} RCB_{1985:4},$$

where RTB is the 91-day Treasury bill yield, RCB is the yield on commercial bank passbook accounts, a1 is the share of M2 represented by NOW accounts and passbook savings deposits, and a2 is the share of M2 represented by deposits paying roughly market rates. RCB, a1, and a2 are both held fixed at their 1985:4 values during the forecasts.

Treasury Bill Rate

$$RTB = (OPP + a1_{1985:4} RCB_{1985:4}) / (1 - a2_{1985:4}).$$

[Changes in the Treasury bill rate were calculated from changes in the M2 opportunity cost, OPP, which were determined by the model.]